NASA's Preparations for ESA's L3 Gravitational Wave Mission

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Outline

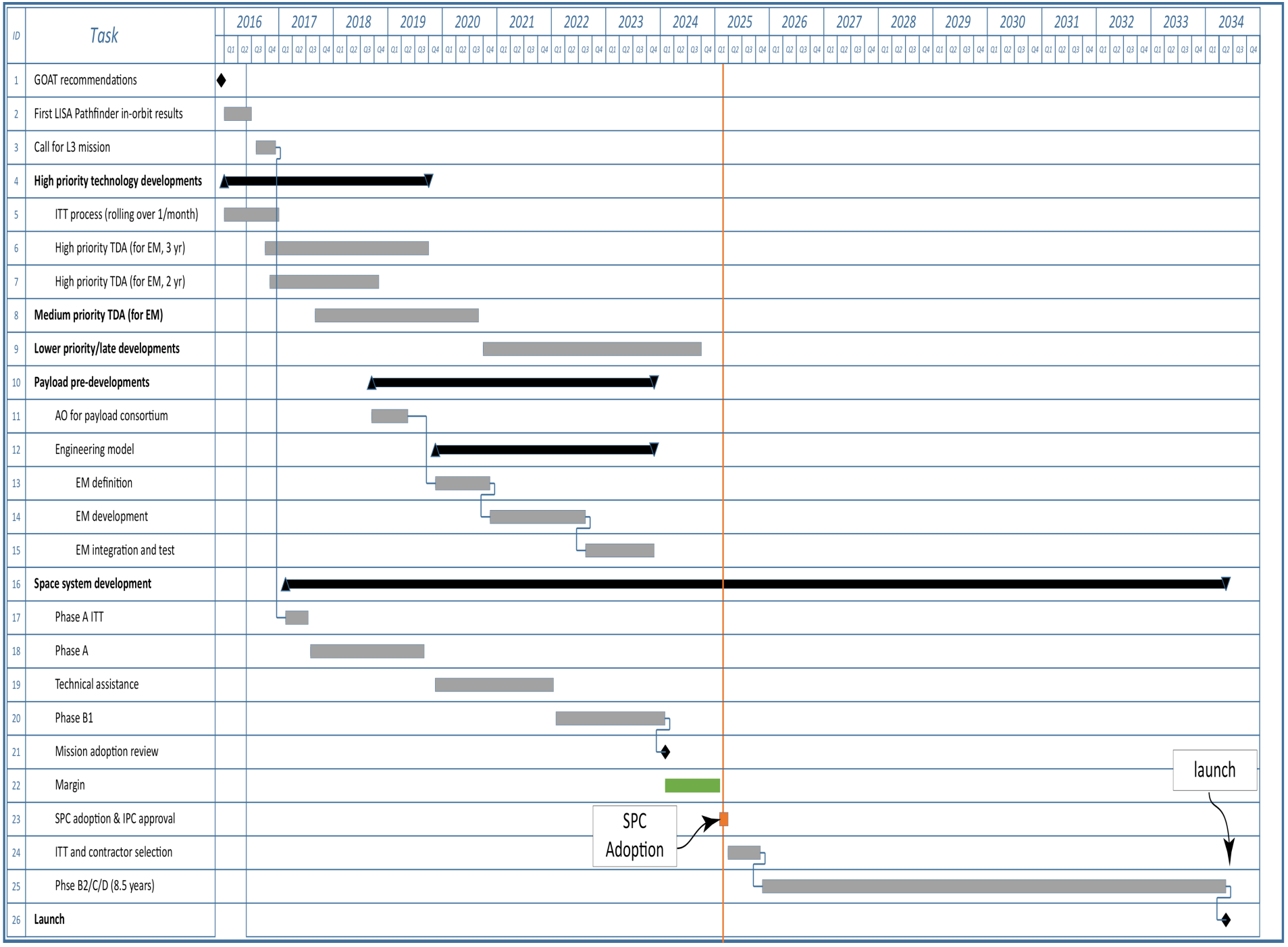
- The backstory
- ESA
  - Cosmic Visions Programme and L3
  - Member States, GOAT, GWOWG
  - LISA Pathfinder
- NASA
  - Technology development
  - ST7
  - L3 Study

The Backstory

- 1993-2011 Joint NASA/ESA studies develop the LISA mission concept.
- 2004 – Joint NASA/ESA LISA Project starts.
- 2010 – NAS/NRC decadal recommends LISA new start, with contingencies.
- 2011 - LISA Project terminated. ESA L1 competition restarted.
- 2013 – ESA selects the gravitational wave science theme for L3, planned for launch in 2034.
- 2012/4 –Astrophysics Implementation Plan sets strategy to seek a NASA role in a ESA mission.
- 2015 - ESA-led LISA Pathfinder launches with NASA's ST7

European Space Agency (ESA)

- 22 Member States (DE, FR, IT, UK, ES, NL, …)
- National Agencies (DLR, CNES, ASI, UKST, …)
- Gravitational waves selected as the science theme for L3, the third large mission in the Cosmic Visions Programme 2015-2025
- 10 Member states want to participate, 3 more expressed interest
- GOAT (2014-2016, R.I.P.) recommended a LISA-like mission (cf. G. Mueller's talk)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1 GOAT recommendations
2 First LISA Pathfinder in-orbit results
3 Call for L3 mission
4 High priority technology developments
5 ITT process (rolling over 1/month)
6 High priority TDA (for EM, 3 yr)
7 High priority TDA (for EM, 2 yr)
8 Medium priority TDA (for EM)
9 Lower priority/late developments
10 Payload pre-developments
11 AO for payload consortium
12 Engineering model
13 EM definition
14 EM development
15 EM integration and test
16 Space system development
17 Phase A ITT
18 Phase A
19 Technical assistance
20 Phase B1
21 Mission adoption review
22 Margin
23 SPC adoption & IPC approval
24 ITT and contractor selection
25 Phse B2/C/D (8.5 years)
26 Launch
SPC Adoption
launch

Current ESA Activities (1/2)

- LISA Pathfinder
  - Launched in 3 Dec. ‘15
  - European science operations started 29 Mar., ending mid June.
  - Performing as expected. First results expected soon.
  - See talks by Slutsky, Thorpe, Hewitson, Hewitson
  - Planning for extended mission
- ESA technology development restarted on laser subsystem, optical bench, telescope.
- Member State technology development encouraged.
- ESA investing in data analysis.

Current ESA Activities (2/2)

- Gravitational Wave Observatory Working Group (GWOWG) stood up.
  - Technical and agency rep from each Member State
  - First meeting April 19th. Complete by September/12 months.
  - Terms of Reference
    - Define a reference mission concept, don't preempt call for concepts
    - 'Express' interests and priorities of Member States
    - Support ESA in discussion of responsibilities with international partners
  - ESA HQ invited, and NASA HQ directed, L3ST to interact with GWOWG

Current NASA Activities (1/2)

- ST7 Disturbance Reduction System (see talk by Cutler)
  - Launched on LISA Pathfinder 3 Dec. ’15
  - NASA commissioning re-starts 20 Jun., operations start 30 Jun., end ~30 Sep.
- GRACE Follow-On in integration: Laser Ranging Interferometer is based on LISA technology. See following talk.
- NASA plan for a gravitational wave mission
  - Negotiate a role in ESA’s L3 mission
  - Cost cap of $100-150M for flight hardware
  - Other activities (science team, data analysis, data archive and distributions, guest investigator program) is additional
- Midterm Assessment
  - Reviews NASA performance against decadal recommendations at the mid-decade
  - Started in October 2015, report due to NASA May 1st.

Current NASA Activities (2/2)

- NASA technology development
  - Main effort: telescope (Sankar talk), thrusters (Cutler talk), phasemeter, laser
  - Other efforts: arm-locking demonstration; torsion pendulum, multi-axis heterodyne interferometry, UV LEDs, optical bench
- L3 Study
  - 15 Members, 6 Technology Analysis Group, ESA Observer
  - Goals
    - Support near-term interactions with ESA and eLISA Consortium
    - Prepare for decadal
  - Activities
    - 7 telecons
    - First face-to-face meeting 19-20 Apr.

Summary

- NASA/ESA partnerships have a long history.
- LISA Pathfinder, a joint ESA/NASA mission, is in progress and performing as expected.
- ESA re-starting and NASA continuing technology development
- ESA has started early lead-in activities for a gravitational wave mission for launch in 2034.
- NASA has started its own lead-in activities, and is joining ESA's activities where appropriate.
- NASA is starting to prepare for the 2020 decadal.